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| 14. ABSTRACT<br>This TOP describes procedures for determining the deviation of the line of sight (LOS) of a sighting system (integrated), or gun/turret drive with respect to initial alignment with a target, without external inputs, as a function of time. Level and canted vehicle orientations are investigated to determine if any interaction exists between azimuth and elevation.<br><br>The reader is referred to TOP 3-2-836 (0) Combat Vehicle Fire Control Systems - Overview Document or International Test Operations Procedure (ITOP) 3-2-836 (0) Combat Vehicle Fire Control Systems - Overview Document.   |                             |                              |  |  |   |  |       |            |                      |     |        |                |                  |                     |               |  |
| 15. SUBJECT TERMS<br><table border="0" style="width: 100%;"> <tr> <td>Drift</td> <td>Drift Rate</td> <td>Angular Displacement</td> <td>Gun</td> <td>Turret</td> </tr> <tr> <td>Combat Vehicle</td> <td>Main Battle Tank</td> <td>Fire Control System</td> <td>Line of Sight</td> <td></td> </tr> </table>   |                             |                              |  |  |   |  | Drift | Drift Rate | Angular Displacement | Gun | Turret | Combat Vehicle | Main Battle Tank | Fire Control System | Line of Sight |  |
| Drift   | Drift Rate                  | Angular Displacement         | Gun                                      | Turret   |   |  |       |            |                      |     |        |                |                  |                     |               |  |
| Combat Vehicle  | Main Battle Tank            | Fire Control System          | Line of Sight                            |  |   |  |       |            |                      |     |        |                |                  |                     |               |  |
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US ARMY DEVELOPMENTAL TEST COMMAND  
TEST OPERATIONS PROCEDURE

\*Test Operations Procedure (TOP) 3-2-836 (2.2.2)

09 November 2009

COMBAT VEHICLE FIRE CONTROL SYSTEMS  
DRIFT

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\*This TOP supersedes ITOP 3-2-836 (2.2.2), dated 27 June 1985.

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## 1. SCOPE.

This document describes procedures for determining the deviation of the line of sight (LOS) of a sighting system (integrated), or gun/turret drive with respect to initial alignment with a target, without external inputs, as a function of time. Level- and canted-vehicle orientations are investigated to determine if any interaction exists between azimuth and elevation.

## 2. FACILITIES AND INSTRUMENTATION.

### 2.1 Facilities.

a. Range facility capable of placement of a graduated gridboard or reference target to minimize focus or parallax errors. A collimator may be used as an alternative.

b. Device capable of canting the test vehicle to an extreme value (minimum 10°).

### 2.2 Instrumentation.

| <u>Devices for Measuring</u>                         | <u>Permissible Error<br/>of Measurement*</u> |
|--|--|
| Angular deviation of LOS<br>(or gun laying position) | 0.10 mrad**                                  |
| Vehicle cant   | 0.5°   |
| Elapsed time   | 0.1 second                                   |

\*The permissible error of measurement (instrumentation) is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

\*\*The preferred unit for angular measurement is the radian. Milliradian (mil) or degree units may be used when required; units of measure must be identified.

## 3. REQUIRED TEST CONDITIONS.

### 3.1 Inspection and Servicing.

a. Ensure that all required system maintenance is performed in accordance with applicable Technical Manuals, Lubrication Orders, or other guidance documents.

b. Verify that the turret-system hydraulic oil is at the proper level, and that the system accumulators are charged to required pressure (if applicable).

c. Ensure that:

(1) All operating systems are up to proper speeds (gyroscopes), and all systems are at normal operating temperatures (electro-optical and mechanical).

(2) The torque friction and backlash at the turret and gun coupling locations are within specified values. If the torque friction and backlash are within specification but not optimal, do not optimize. The test should be conducted within the specification range.

(3) The gun balance complies with specified values as applicable. Provide weight compensation for any installed instrumentation to maintain proper balance as necessary.

(4) The weapon/sight system is centered over the vehicle front (12 o'clock position).

### 3.2 Stowage.

a. Stow the test vehicle with the required complement of ammunition (actual or simulated) and all items of on-equipment materiel (actual or simulated) to provide the moment of inertia and center of gravity of a combat loaded vehicle.

b. Attach all equipment (or stimulant) to the gun that is normally attached during combat, e.g., searchlight, telescope, coaxial machinegun, machinegun ammunition belt, ballistic shield.

c. Load a dummy round of ammunition, simulating the primary round carried by the vehicle, in the gun during all nonfiring stabilization system tests.

### 3.3 Safety.

Safety procedures pertinent to the test area and test vehicle should be adhered to at all times. The following procedures should be considered.

a. Inspect the system for safety hazards before testing, and continually monitor the system for hazards during testing.

b. Use experienced vehicle operators who have received training on the test system.

c. Ensure that adequate protective clothing is worn, e.g., helmets, safety shoes, eye and ear protection.

## 4. TEST PROCEDURE.

a. Position the vehicle with the turret level within 1°.

b. Attempt to neutralize or minimize the system drift by following the prescribed procedures in the appropriate Technical or Operator's Manual for the system under test.

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c. Establish an initial reference LOS measurement with the gridboard or align a reference point on the sight reticle to a point on the target (if a graduated reticle is used as a reference for angular displacement relative to a point down range).

d. Activate or engage the fire control system.

e. For each axis, record the angular displacement (drift) for 10 minutes. Ideally, data should be recorded at a rate of 1 second but a 15-second interval is acceptable. If facility constraints prevent a 10-minute data collection, every attempt should be made to achieve at least a 3-mrad displacement.

f. Repeat steps 4b through 4e above for a relatively large vehicle cant angle (such as 10°). Repeat again for a similar large cant in the opposite direction.

g. Repeat steps 4a through 4f for each system operating configuration, such as stabilized sight/slaved weapon, stabilized weapon/slaved sight, engine on/engine off, etc.

## 5. DATA REQUIRED.

Record the following data:

a. Description of test setup, instrumentation used, vehicle cant, and system configuration or operating mode.

b. Angular displacement of LOS (or weapon/turret) as a function of elapsed time.

c. Observation of any system peculiarities.

## 6. PRESENTATION OF DATA.

a. For each system configuration or operating mode (including level or canted):

(1) Graphically present horizontal and vertical axis, drift (angular displacement versus time. Additionally, present a linear (first order) fit for the data points. Figure 1 shows a representative plot.

(2) Tabulate the initial 15-second drift value (angular displacement), a longer (10-min or maximum achievable) drift value and the slope of the linear fit of the plot made in paragraph 6a(1) above.

b. Report any peculiar observations.

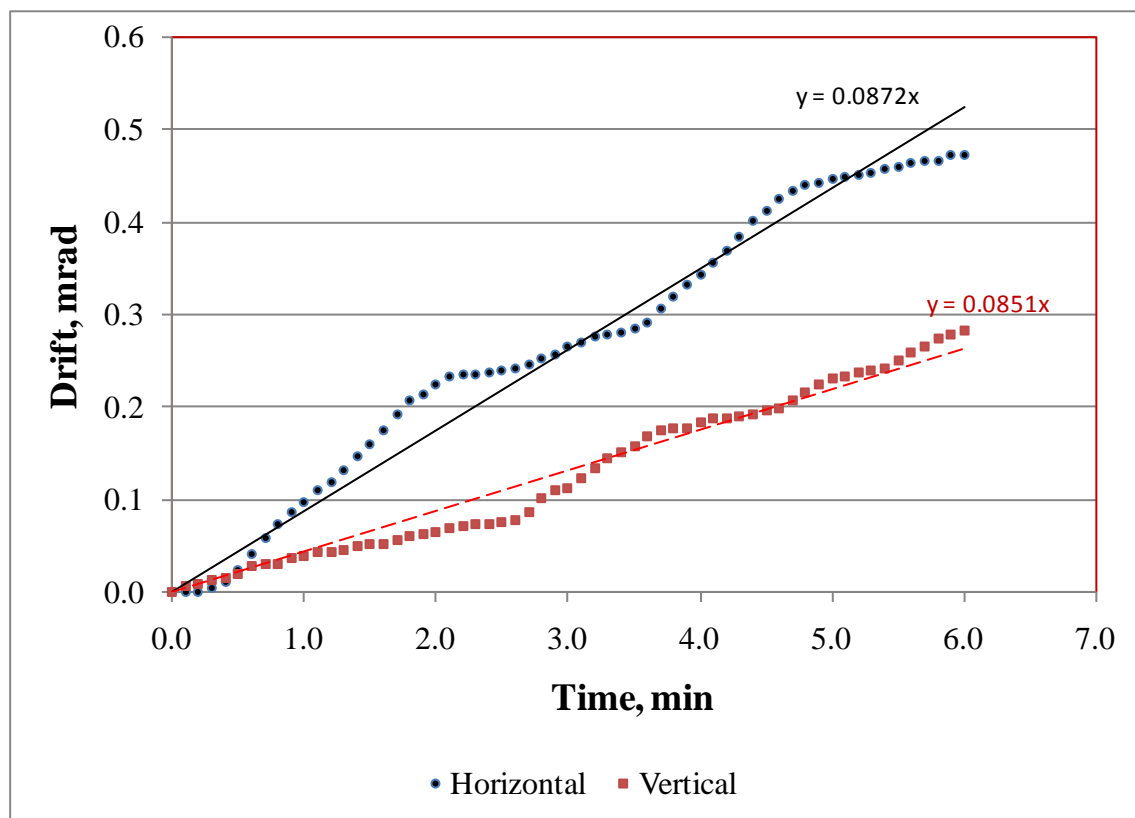


Figure 1. Drift versus time

Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Test Business Management Division (TEDT-TMB), US Army Developmental Test Command, 314 Longs Corner Road, Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: US Army Aberdeen Test Center (TEDT-AT-ADF), 400 Collieran Road, Aberdeen Proving Ground, MD 21005-5059. Additional copies can be requested through the following website: <http://itops.dtc.army.mil/RequestForDocuments.aspx>, or through the Defense Technical Information Center, 8725 John J. Kingman Road, Suite 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.